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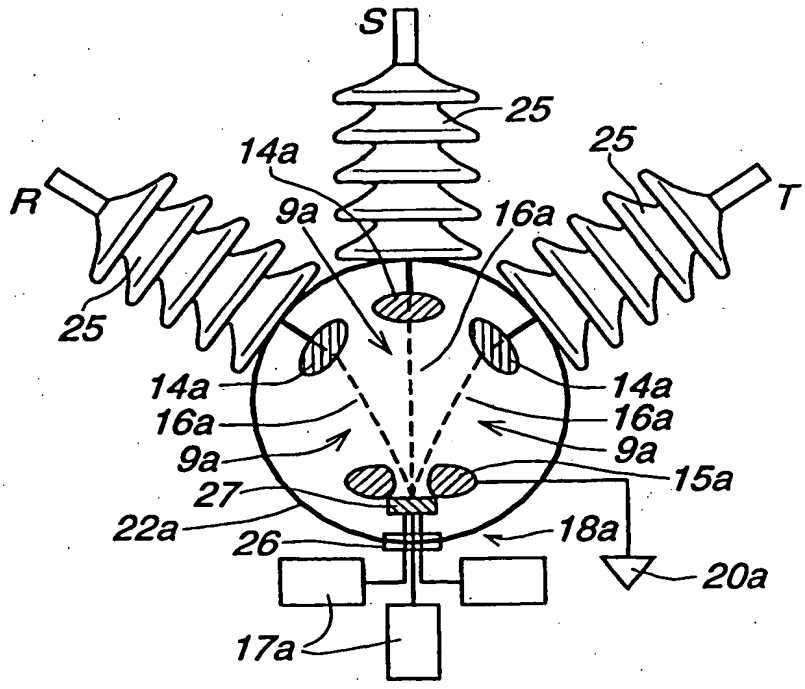
(57) Abstract

A device for protecting, in a multiphase electric power plant for alternating voltage, one or more objects from over-currents and/or over-voltages, said objects being connected to an electric power network or another equipment comprised in the electric power plant, said device comprising an arrangement for reducing over-currents and/or over-voltages, said arrangement being activatable with the assistance of an arrangement detecting over-current and/or over-voltage conditions. The arrangement reducing over-currents and/or over-voltages comprises a plurality of electric closing means (9a), which each are coupled to phase conductors in the plant and which are closable to reduce occurring over-currents and/or over-voltages. Said plurality of closing means (9a) have their electrode gaps (16a) arranged within an enclosure (22a) common to the closing means. The device and the closing means (9a) thereof may also be used for general switching purposes.



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A switching device

FIELD OF THE INVENTION

This invention is related to device according to the precharacterising part of enclosed claim 1. The device may be used for common switching purposes but is with particular advantage useful for protection of electrical objects.

The electrical objects in question may be of arbitrary nature as long as they are contained in an electric power plant and requires protection against fault-related over-currents, i.e. in practice short circuit currents. As an example, it may be mentioned that the object may be formed by an electrical apparatus having a magnetic circuit, e.g. a generator, transformer or motor. Also other objects may be in question, e.g. power lines and cables, switchgear etc. The present invention is intended to be applied with medium and high voltage. According to IEC-standard, medium voltage concerns 1-72.5 kV whereas high voltage is > 72.5 kV. Accordingly, transmission, sub-transmission and distribution levels are included.

In prior electric power plants of this nature one has relied, to protect the object in question, on a conventional circuit breaker (electric switch) of such a design that it provides for galvanic separation on breaking. Since this circuit breaker must be designed to be able to break very high currents and voltages, it will obtain a comparatively bulky design having a large inertia, which reflects itself in a comparatively long breaking time. It is pointed out that the over-current primarily intended is the short

circuit current arising in connection with the protected object, e.g. as a consequence of faults in the electrical insulation system of the protected object. Such faults cause the fault current (short circuit current) of the external network/equipment to tend to flow through the light arc. The result thereof may be a very large failure. It may be mentioned that the dimensioning short circuit current/fault current for the Swedish power network is 63 kA. In reality, the short circuit current may be 40-50 kA.

A problem with the circuit breaker mentioned is the extended breaking time thereof. The dimensioning breaking time (IEC-standard) for completely performed breaking is 150 milliseconds (ms). It is difficult to reduce this breaking time to less than 50-90 ms depending on the operational case. The consequence is that when a fault in the protected object occurs, a very high current will flow through the same during the entire time required for causing the circuit breaker to break. During this time the full fault current of the external power network involves a substantial strain on the protected object. In order to avoid damages and total failures with regard to the protected object, one has constructed, in accordance with the prior art used until now, the object so that it should be capable of withstanding the short circuit current/fault current during the breaking time of the circuit breaker without appreciable damages. In this connection it is pointed out that a short circuit current (fault current) in the protected object may be composed of the own contribution to the fault current of the object itself and the current addition emanating from the network/equipment. The own contribution of the object to the fault current is not influenced by the operation of the circuit breaker but the contribution to the fault current from the network/equipment depends on the operation of the circuit breaker. The need for constructing the protected object so that it endures a high short circuit current/fault current during a considerable time involves substantial disadvantages in the form of a more expensive design and reduced performance.

OBJECT OF THE INVENTION

The object to the present invention is to device ways to design the device so as to achieve a solution efficient with regard to function and construction. Secondarily, the invention aims at achieving a better protection for the objects in question and, accordingly, a smaller strain thereon.

SUMMARY OF THE INVENTION

According to the invention, the above object is achieved by the device according to the invention comprising a plurality of electric closing means, which each are coupled to phase conductors in the plant, and by said plurality of closing means being combined to a closing assembly, in which at least an essential part is common to the closing means. According to an embodiment the device comprises an arrangement, which reduces over-currents and/or over-voltages and which comprises the closing means, said arrangement being activatable with the assistance of an arrangement detecting over-current and/or over-voltage conditions.

The invention creates possibilities for a very efficient protection function as a consequence of use of the electric closing means, functional and constructive advantages being, in addition, achievable by combining the closing means to a single closing assembly comprising at least an essential common part.

According to a possible embodiment of the invention the electrode gaps of the closing means are arranged within an enclosure common to the closing means. This enclosure is normally intended to be put under over-pressure and contain a gas or gas mixture suitable for the closing function. The over-pressure conditions mean that the enclosure becomes comparatively bulky and costly. By providing a common enclosure for the electrode

gaps of two or more of the closing means, the design becomes less costly and more compact.

According to another embodiment of the invention, the energy supply members comprise an energy source common to the closing means and an energy direction system to direct energy to the electrode gap of that or the closing means intended to be activated. Thus, this design has the consequence that one energy source is sufficient despite the presence of a plurality of electrode gaps. The presence of a single energy source for several closing means has developed into the embodiment that the energy direction system is adapted to simultaneously direct energy to two or more of the electrode gaps. Although only one single energy source occurs, it is in this way possible to achieve simultaneous closing of two or more of the electrode gaps.

An embodiment as non-expensive and compact as possible is achieved in case in one and the same design two or more of the electrode gaps of the closing means are located within one and the same enclosure at the same time as one single energy source occurs for all closing means or at least for two or more of them.

It is preferred that the energy used for causing the electrode gaps to assume conductivity is radiation energy supplied directly to the electrode gaps for the purpose of ionising the same. Furthermore, it is preferred that the radiation energy is constituted by energy from a laser. As mentioned hereunder, also other embodiments are possible.

Further advantages and features of the invention appear from the following description and the claims.

SHORT DESCRIPTION OF THE DRAWINGS

With reference to the enclosed drawings, a more specific description of embodiment examples of the invention follows hereunder.

In the drawings:

Fig 1 is a diagrammatical view illustrating the protection device according to the invention applied in an electric power plant for protecting an electrical object, e.g. a rotating electric machine, here in the form of a generator;

Fig 2 is a view similar to the one in fig 1 but illustrating another embodiment;

Fig 3 is a diagrammatical view illustrating a closing means designed in accordance with the invention and in a basic form;

Fig 4 is a diagrammatical view illustrating an embodiment where an enclosure is common to several closing means;

Fig 5 is a further embodiment, where a single energy source, in particular a laser, is common to several closing means;

Fig 6 is a view similar to fig 5 but illustrating an embodiment modified in the sense that the electrode gaps of the closing means are located within a common enclosure;

Fig 7 is an alternative embodiment similar to the one in fig 4, although one single energy source occurs in the embodiment according to fig 7;

Fig 8 is a diagrammatical view illustrating how two closing means connected between two phases in a three phase system are associated to each other; and

Fig 9 is a view illustrating the closing means according to fig 8 but now completed with an energy source common to the closing means.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig 1 illustrates an electric power plant, in which an object 1 to be protected is comprised. This object is in the example conceived to consist of a generator, the stator windings of which are denoted 2. The zero point 3 of the generator is either without system grounding or otherwise there exist as "system grounding" a relatively high-ohm grounding, for instance by means of the resistor 4. In the example the plant has three phases with the phase conductors R, S and T. The invention is applicable to multiphase embodiments where the number of phases are lower as well as higher than three.

The generator 1 is in connection with an external delivery network 5 via the phase conductors R, S, T. Instead of such a network, the unit denoted 5 could be formed by another equipment contained in the electric power plant.

It is pointed out that it primarily is the generator 1 proper which is intended to be protected against fault currents from the network/equipment 5 when there occurs in the generator 1 proper a fault giving rise to a fault current from the network/equipment 5 towards the generator so that the fault current will flow therethrough. Said fault may e.g. consist in a ground fault having been formed in the generator 1.

It is pointed out that detrimental short circuit currents/fault currents in some types of protected electrical objects 1, as for instance generators, may flow from the object 1 towards the network/equipment 5. It is within the frame of the invention that it may be used for protection purposes not only for protecting the object 1 from externally emanating fault currents flowing to the object but also internal fault currents in the object flowing in the opposite direction.

In the following the reference character 5 will to simplify the description always be denominated as consisting of an external electric power network. However, it should be kept in mind that instead of such a network it may be the question of another equipment which when a fault occurs causes violent current flow through the object 1.

It appears from Fig 1 that conventional circuit breakers 6 are provided in the phase conductors R, S, T. These circuit breakers comprise at least one own sensor for sensing circumstances indicative of an over-current flowing in one or some of the phase conductors R, S, T. Such circumstances may be currents/voltages but also other indicating that a fault is at hand. For instance, the sensor may be an arc sensor or a sensor detecting short circuit sound etc. When the sensor indicates that the over-current exceeds a certain level, the circuit breakers 6 are activated for breaking the connections between the generator 1 and the network 5. However, the circuit breakers 6 have to break the total short circuit current/fault current. Thus, the circuit breakers must be designed to fulfil severe requirements, which in practice means that they will operate relatively slowly. The circuit breakers 6 are of such a design that they establish galvanic separation by moving metallic contacts apart. Accordingly, the circuit breakers 6 comprise normally required auxiliary equipment for arc extinguishing.

According to the invention there is an arrangement generally denoted 7 for over-current reduction, said arrangement being activatable for over-current reduction with the assistance of an arrangement 8 detecting over-current conditions. The over-current reducing arrangement 7 comprises a plurality of electric closing means 9.These closing means are connected between the respective phase conductor R, S, T and ground 13 or otherwise another unit having a relatively low potential. In the example illustrated in fig 1, there occurs three phase conductors. In such a case the closing means 9 are three in number. The over-current reducing arrangement 7 comprises further a control unit 10 adapted to control control means denoted 11 and being in their turn adapted to cause the closing means 9 to assume an electrically conducting state. The over-current reducing arrangement 7 is activatable for over-current reduction within a time period substantially shorter than the breaking time of the circuit breakers 6.

When a fault occurs, this is registered by the arrangement 8 detecting over-current conditions and information is supplied to the control unit 10. This controls in its turn the closing means 9 to short circuit the three phase conductors R, S, T to ground. This short circuiting is intended to be effected within some or few ms after unacceptable fault conditions having been detected. It is aimed at to carry out current reduction in a shorter time period than 1 ms, and preferably more rapidly than 1 microsecond. Simultaneously, the circuit breakers 6 are controlled to open but this requires a considerable time.

It is pointed out that it is not necessary under all circumstances to close all closing means 9; it may be sufficient to only close that closing means which is connected to the conductor R, S, T in which the fault has occurred. In fig 2 an alternative embodiment is illustrated which is closely related to the one in fig 1 but the important difference is the following: in fig 2 there occurs only two closing means 9, which each are coupled between

phase conductors in the plant and which are closable to bring each individual phase conductor into electric connection with a further phase conductor. Expressed in other words, the two occurring closing means 9 are intended, in the embodiment according to fig 2, to effect, between pairs of phase conductors, such connections which substantially reduce fault currents. The measure to short circuit, with the assistance of two closing means in a manner appearing from fig 2, the phases in a multiphase plant is in reality equivalent to provide a particular closing means for each of the phase conductors and connect this closing means between the phase conductor and ground.

Above it has been described that the embodiment according to figs 1 and 2 is suitable for over-current reduction. It is, however, also well suited for over-voltage reduction, i.e. that when an over-voltage surge arrives on the network and is detected by means of the detector arrangement 8, all closing means 9 or only that closing means which is the one most closely involved may be closed very rapidly, by control from the control unit 10, to allow such current diversion required for elimination of the over-voltage.

Fig 3 is a diagrammatical view of a closing device for the purpose of disclosing the most important features thereof.

The closing means 9 comprises electrodes 14, 15 and a gap 16 present therebetween. The closing means 9 proper comprises members to trigger the electrode gap to form an electrically conducting path between the electrodes 14, 15. A control means 11 is adapted to control operation of the members 17, 18. These members 17, 18 are in the example arranged to cause or at least initiate the electrode gap 16 to assume electric conductivity by energy supply. This energy supply is intended to provide the gap 16 or a part thereof to form a plasma. It is essential that the members 17, 18 are capable of supplying triggering energy

with a great speed to the electrode gap for a rapid function. Even if, as will be described later, other ways to supply energy to the electrode gap may be in question, it is preferred that the supply occurs in the form of radiation energy, i.e. as an electromagnetic wave motion.

The members 17, 18 comprise at least one radiation source 17 which by energy supply to the electrode gap 16 causes ionisation/plasma formation in at least a part of the electrode gap, and a radiation direction system 18.

According to the invention it is preferred to supply, by means of the laser 17 or other members energy to the electrode gap 16 so that almost momentarily the entire electrode gap is ionised and brought to the form of a plasma respectively so that also the entire gap 16 is immediately brought to electric conductivity. According to the invention it is preferred that the radiation energy is supplied in one or more elongated areas extending continuously or substantially continuously between the electrodes. It is then preferred that the radiation energy is applied along one or more lines 19 extending between the electrodes 14, 15. When coupling the closing means 9 between a high voltage point and ground (or another unit with a lower potential) as diagrammatically indicated in fig 3, i.e. with the electrode 14 connected by means of the connection member 8 and the electrode 15 connected to ground 20 by means of a connection member 21, there will exist between the electrodes a voltage difference giving rise to an electric field. This field is used for promoting or driving an electric break through between the electrodes as soon as the members 17, 18 have been controlled to triggering, i.e. given rise to ionisation/plasma formation in one ore more parts of the electrode gap 16. This established ionisation/plasma formation will be driven by the electric field to bridge the gap between the electrodes to obtain in this way a low resistive electrically conducting channel, i.e. a light arc, between the electrodes 14, 15. However, it is pointed out that the invention is not intended to

be restricted only to application on occurrence of rather important electric fields. Thus, the intention is that the members 17 ,18 should be capable of establishing electric conduction between the electrodes also with a relatively weak field.

Due to the requirement on the closing means 9 to close very rapidly for current diversion, it is, accordingly, desirable that at least a part of the gap is ionised and that the closing means is dimensioned so that the strength of the electric field in the gap 9 becomes sufficiently high for safe closing. On the other hand it is, however, a desire that the closing means 9 in its insulating state of rest should have a very high electric strength against break through between the electrodes 14, 15.

As appears from fig 3 the electrode gap 16 is enclosed in a suitable enclosure 22. In the gap 16 there may exist a vacuum as well as a medium suitable for the purpose in the form of gas or even liquid, possibly under over pressure. Furthermore, the electrode denoted 15 may comprise an opening 12, through which the radiation direction system 18 is adapted to direct radiation energy emitted from the laser 17 to the area 19.

The radiation direction system 18 comprises here a mirror 23 for direction change of the collimated radiation, which emanates from the laser 17 and reaches a direction element 24. This direction element 24 applies the radiation energy in the electrode gap 5 via the opening 12 in the electrode 15, the radiation energy being applied along a line either such that the radiation energy is substantially constant along this line or such that the energy is supplied in a plurality of spots or sub-areas along this line. Expressed in other words, the purpose is that the radiation energy should by applied in an elongated rod-like shape between the electrodes 3, 4 for creating conditions as favourable as possible for induction of a light arc between the electrodes. The radiation energy is intended to give rise to ionisation/plasma formation in said elongated rod-shaped area so that

a light arc is formed between the electrodes, either with the assistance of a voltage difference over the electrodes or without such a voltage difference. In the preferred embodiment the enclosure 22, and accordingly the electrode gap 16, contains a gas or gas mixture put under over-pressure. As indicated in fig 1 there are suitable sealings in connection with all lead-throughs through the enclosure 11.

According to the invention the occurring plurality of closing means 9 are combined to a closing assembly, in which at least one essential part is common to the closing means. This means that in a normal situation a plurality of closing means forming a set intended for the multiphase network are included in said closing assembly. In for instance a three phase network, it is according to the embodiment in fig 1 three closing means contained in the assembly. On the contrary, only two closing means are included in the embodiment according to fig 2. The expression "a plurality" in connection with the number of closing means should, accordingly, be interpreted as from two and upwards.

Fig 4 illustrates a first embodiment according to the invention. In this case the electrode gaps 16a of the closing means are arranged within an enclosure 22a common to the closing means 9a. Each electrode gap 16a has its own high voltage electrode 14a but the low voltage or ground electrode 15a is common to all electrode gaps.

The high voltage electrodes 14a are angularly spaces within the enclosure 22a so that the direction from the electrode 15a to the other electrodes 14a becomes varying. For connection of the high voltage electrodes 14a there are placed isolators 25 on the outside of the enclosure 22a.

In the embodiment according to fig 4 there occurs three different energy sources in the form of lasers 17a. The radiation from these lasers enters into the enclosure 22a through a window 26.

The energy direction system 18a is present within this enclosure. The energy direction system is in the example conceived to comprise one or more radiation directing elements. These elements are arranged so that when a selected one of the lasers 17a is started for delivering energy, the energy direction system 18a will direct the radiation from this laser to a predetermined of the electrodes 14a. The same applies for the rest also for the two other lasers. The control unit 10 of the device is in controlling connection with the lasers 17a so that the latter may be caused to deliver energy individually or two or more simultaneously depending upon what is required.

Fig 5 illustrates a variant where a single energy source 17b in the form of laser is intended to deliver energy to the three closing means 9b. The light emitted from the laser 17b is separated for instance by means of dicroic mirrors or beam dividers 23b with different reflectance so that the same laser pulse energy shall be able to trigger the three closing means 9b. Besides shutters 27 of electrooptical or other type are comprised in each of the three beam paths. These shutters 27 may, by means of the control unit 10b, be caused to shut or open for a part amount of the radiation emanating from the laser 17b.

The components 27 must of course be designed so that each closing means 9b obtain equal triggering energy.

In this embodiment each closing means 9b is conceived to have its own enclosure 22b in a manner diagrammatically appearing by the figure.

In use of the embodiment according to fig 5, the laser is started when closing of one or more of the closing means 9b is required. By opening, by means of the control unit 10b, one or more of the shutters 27 controlling radiation passage, radiation energy may be supplied to that or the closing means 9b to be brought to electric breakthrough.

A variant of the embodiment illustrated in fig 5 is illustrated in fig 6. The variant according to fig 6 consists in that the enclosure 22e here encloses the occurring closing means 9e, their electrodes and electrode gaps. In this embodiment there is, accordingly only one enclosure 22e and only one energy source 17e. The embodiment may, thus, be comparatively non-extensive and compact. In other regards the embodiment corresponds to what has been described with assistance of fig 5.

Fig 7 illustrates a variant of the embodiment according to fig 4. More specifically, the change in fig 7 is that the closing means 9c with associated electrode gaps arranged in one and the same enclosure 22c as in fig 4 are supplied with energy from one single energy source 17c. In this embodiment the energy direction system 18c comprises one or more components 27c, which are under control by the control unit 10c and which are capable of deflecting the radiation arriving from the energy source 17c towards a selected one of the electrodes 14c. If so desired and if the effect of the energy source 17c is sufficient, the direction elements 27 may in this embodiment be arranged to direct the radiation to all occurring electrodes 14c simultaneously.

Figs 8 and 9 illustrate an application corresponding to the one in fig 2. The closing means 9d are present between the phases R, S and T. Their electrode gaps 16d comprises a combinatory effect in the sense that the electrode 15d is included in a common arrangement for the closing means 9d.

It appears further from fig 9 that one single energy source 17d is common to the two electrode gaps 16d. The energy source 17d delivers energy, which via an energy direction system 27d is intended to be supplied to the electrode gaps 16d simultaneously so that normally the electrode gaps 16d always are brought to a conducting state when a fault occurs. It is in this connection pointed out that it would be possible to design the energy supply

system so that it would be capable of supplying energy to one of the electrode gaps 16d at a time.

The embodiments described have, accordingly, the advantage that one or more parts become common in the respective constructions, which is favourable from the point of view of costs and simplifies the constructions. It may also be essential for functional reasons to carry out such combining to an assembly as proposed according to the invention; if energy from one and the same energy source is used for triggering two or more electrode gaps simultaneously there may in certain cases arise a greater probability for the electrode gaps really being fired simultaneously than if instead separate energy sources would be at hand.

It should be noted that the above presented description only should be considered as exemplifying for the inventive concept, on which the invention is based. Thus, it is obvious for men skilled within this art that detailed modifications can be made without for that sake leaving the frame of the invention. As an example, the closing device according to the invention may be used for general switching purposes if so desired. Furthermore, it may be mentioned as an example that it is not necessary according to the invention for supply of ionisation/plasma formation energy to the electrode gaps to use such based upon radiation. Even less must the energy necessarily be laser radiation even if this is an attractive alternative from many viewpoints. Accordingly, closing of the closing means could occur by supplying energy to the closing means in another way, e.g. by particular firing members, electron canons, x-ray tubes etc. Also other modifications are possible within the scope of the invention. Thus it may be mentioned that in case several electrode gaps are located in one and the same enclosure, it is possible and suitable to place screen elements between the electrode gaps to reduce the risk for firing the wrong electrode gap.

CLAIMS:

1. A device for switching electrical effects in a multiphase electric plant for alternating voltage, ***characterized*** in that the device comprises a plurality of electric closing means (9), which each are coupled to phase conductors (R, S, T) in the plant, and that said plurality of closing means (9) are combined to a closing assembly, in which at least an essential part is common to the closing means.

2. A device according to claim 1, for protection of one or more objects (1) from over-currents and/or over-voltages, said objects being connected to an electric power network (5) or another equipment contained in the electric power plant, ***characterized*** in that the closing means (9) are comprised in an arrangement (7) reducing over-currents and/or over-voltages, said arrangement (7) being activatable with the assistance of an arrangement (8) detecting over-current and/or over-voltage conditions.

3. A device according any preceding claim, **characterized** in that it comprises a control unit (10) connected to the closing means (9) and to the arrangement (8) detecting over-current and/or over-voltage conditions, said control unit being adapted to control, with assistance of information from the arrangement, the closing means to close when required for reasons of protection.

4. A device according to any preceding claim, **characterized** in that the closing means (9) comprise an electrode gap (15), which is convertible between an electrically substantially insulating state and an electrically conducting state, and members (17, 18) for causing or at least initiating the electrode gap (16) or at least a part thereof to assume electric conductivity and that the members (17, 18) to cause of at least initiate the electrode gap to assume conductivity are adapted to

supply energy to the electrode gap to bring the gap or at least a part thereof to the form of plasma.

5. A device according to claim 4, **characterized** in that the energy is radiation energy.

6. A device according to claim 4 or 5, **characterized** in that the members for causing or at least initiating the electrode gap or a part thereof to assume electric conductivity comprise at least one laser (17).

7. A device according to any of claims 4-6, **characterized** in that the electrode gaps (16a, 16e) of the closing means are arranged within an enclosure (22a, 22e) common to the closing means.

8. A device according to any of claims 4-7, **characterized** in that the energy supply members comprise an energy source (17b, 17c) common to the closing means and an energy direction system (18) to direct the energy to the electrode gap of that or the closing means intended to be activated.

9. A device according to claim 8, **characterized** in that the energy direction system (17b, 18b, 18c) is arranged to direct energy to any selected of the electrode gaps.

10. A device according to any of claim 8, **characterized** in that the energy direction system (18b, 18c) is arranged to simultaneously direct energy to two or more of the electrode gaps.

11. A device according to preceding claim, **characterized** in that the energy direction system (18a) comprises means (27) for screening off one or more of the electrode gaps from energy supply.

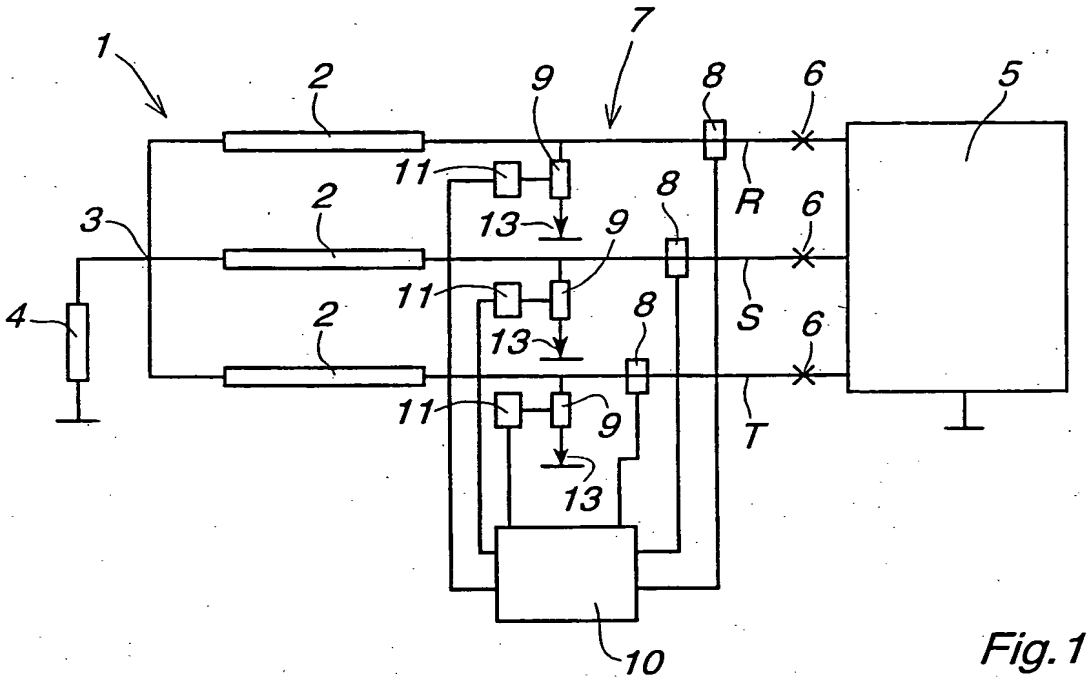

Fig. 1

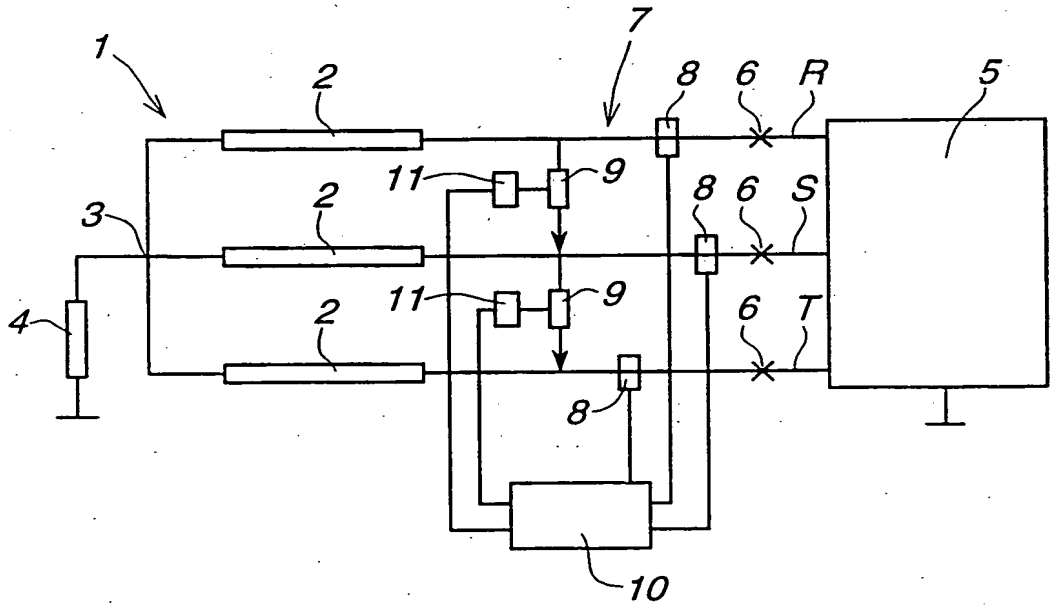

Fig. 2

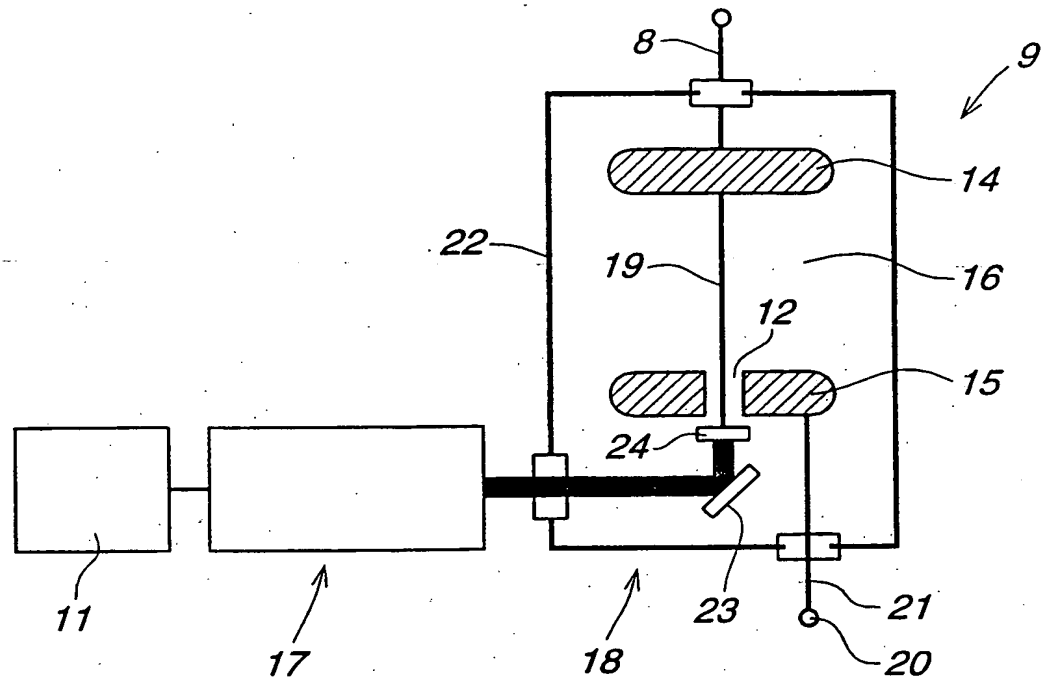
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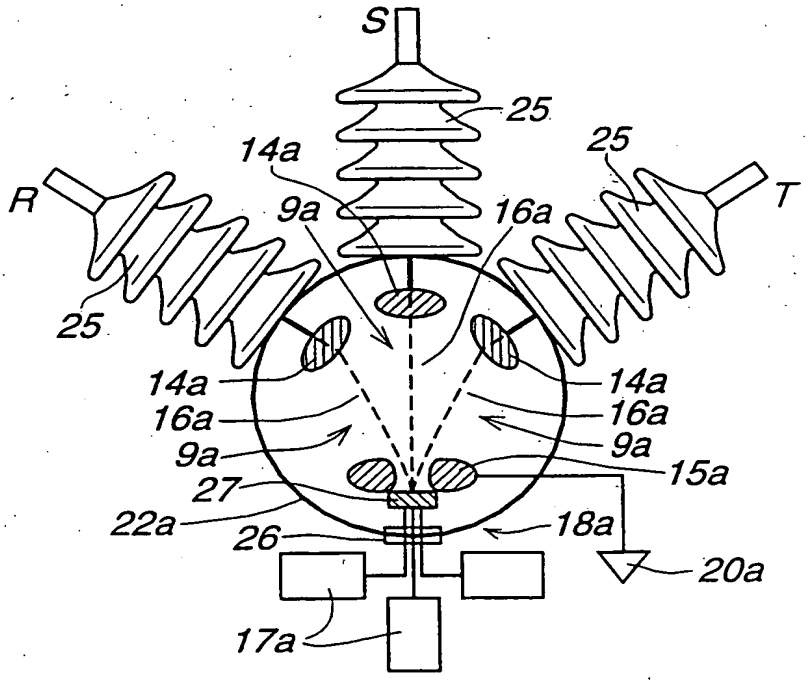
Fig. 3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R
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16a
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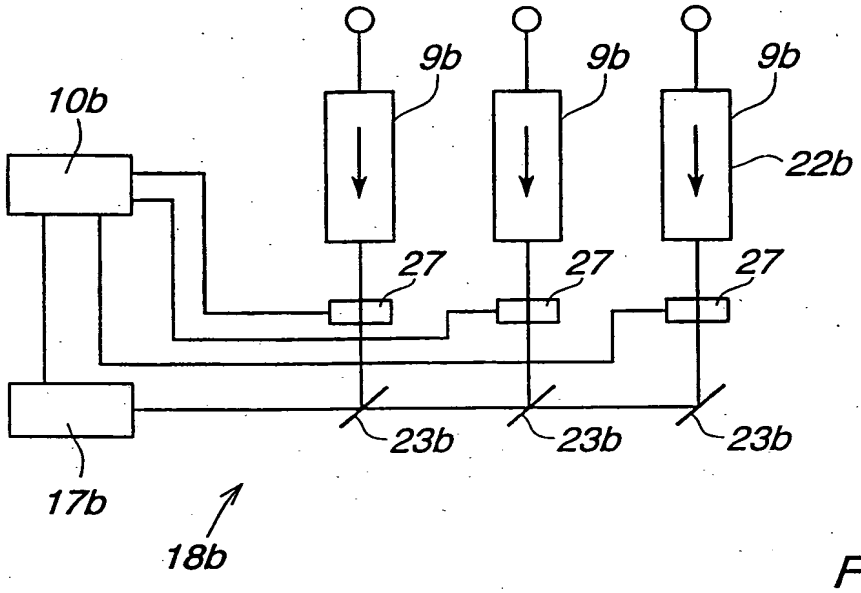
20a
17a

Fig. 4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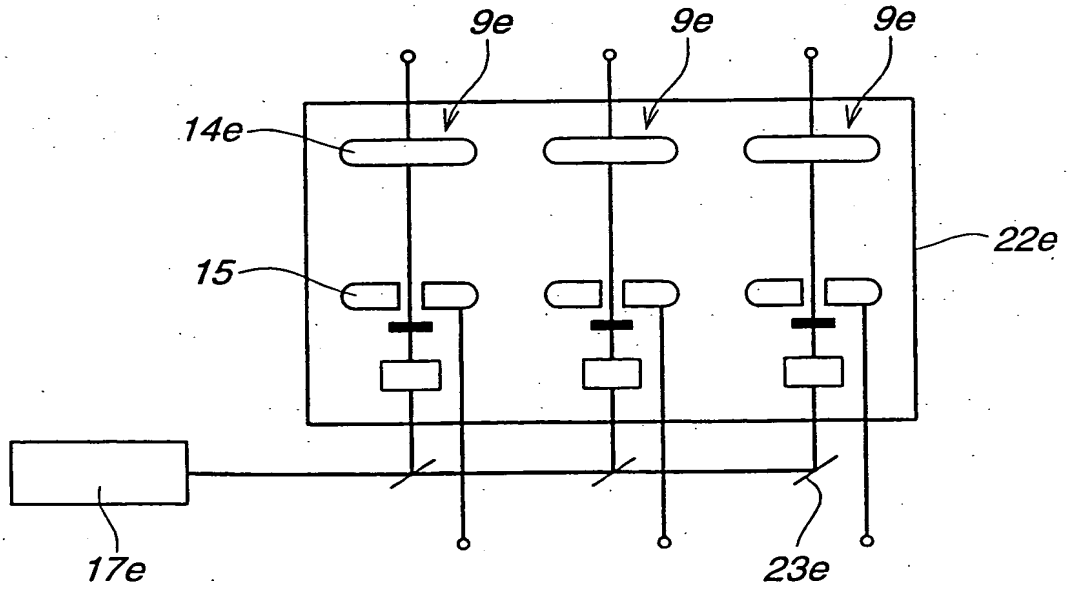
23b
17b
18b

Fig. 5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22e
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23e

Fig. 6

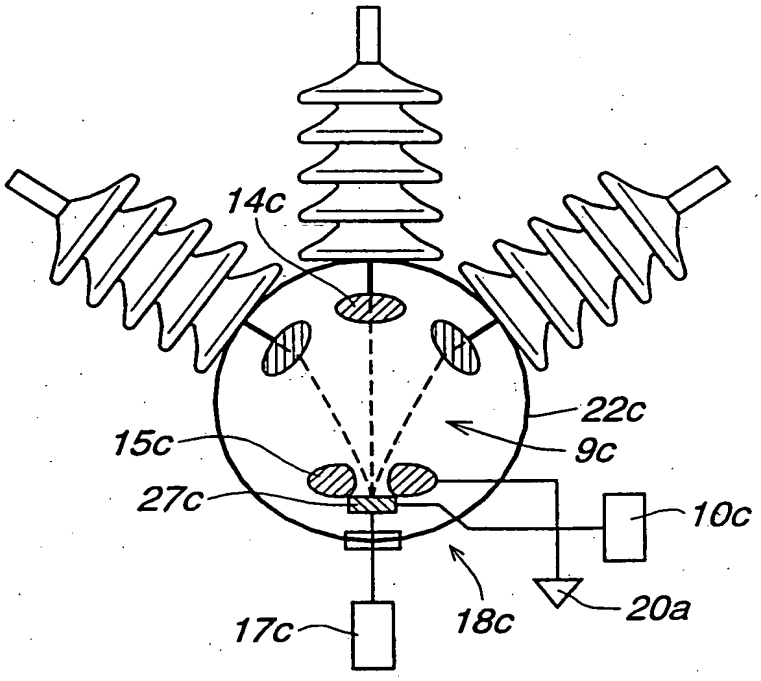

Fig. 7

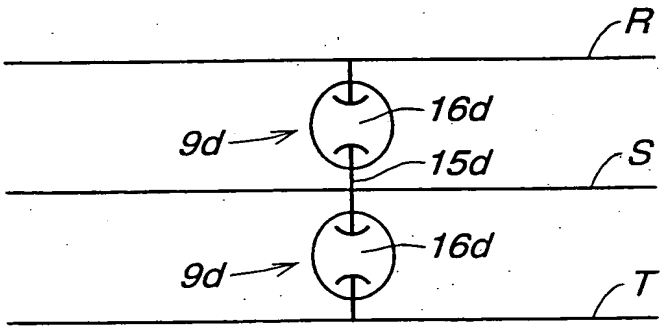

Fig. 8

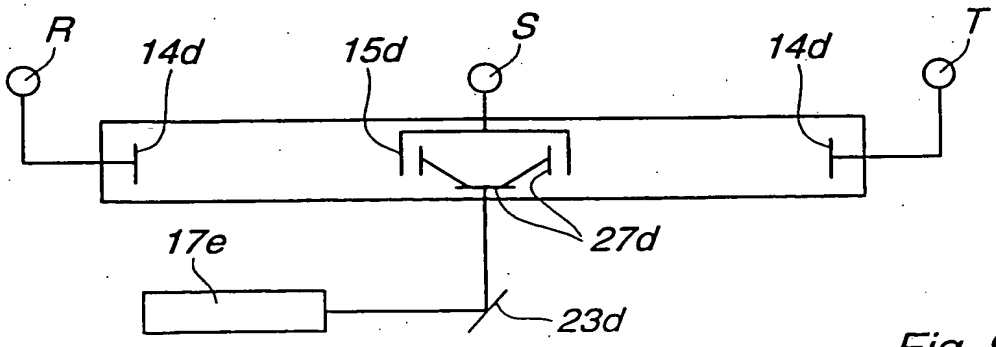

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/01101

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02H 9/00, H01T 2/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01T, H02H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3660721 A (L.L. BAIRD), 2 May 1972 (02.05.72), column 2, line 22 - column 6, line 2, figures 1,2 --	1-11
X	EP 0280759 A1 (WESTFÄLISCHE BERGGEWERKSCHAFTSKASSE), 7 Sept 1988 (07.09.88), column 7, line 6 - line 53, figures 1,2 --	1-3
A	US 4184186 A (P. BARKAN), 15 January 1980 (15.01.80), column 14, line 48 - column 16, line 49, figures 1,2,11,12 --	1-3

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 October 1999	16 -10- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Bertil Nordenberg/AE Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/01101

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4978893 A (P.J. BRANNON ET AL.), 18 December 1990 (18.12.90), figure 1, abstract -- JP 8167360 A (TOSHIBA KK) 1996-06-25 (abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 1999-09-29). Retrieved from: EPO WPI Database. DW9635, Accession No. 96-352088; &JP 8167360 (TOSHIBA CORP) 1996-10-31 (abstract).(online)(retrieved on1999-09-29). Retrieved from: EPO PAJ Database -- US 3398322 A (A.H. GUENTER), 20 August 1968 (20.08.68), column 2, line 44 - column 4, line 75, figures 1-5 -- --------	5,6 5,6 5-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SE 99/01101

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3660721 A	02/05/72	NONE	
EP 0280759 A1	07/09/88	DE 3787798 D	00/00/00
US 4184186 A	15/01/80	NONE	
US 4978893 A	18/12/90	NONE	
US 3398322 A	20/08/68	NONE	

A SWITCHING DEVICE

Patent number: WO9967865
Publication date: 1999-12-29
Inventor: EKBERG MATS (SE); SKYTT PER (SE); WINDMAR DAN (SE); SUNDIN MARIE (SE); SUNESSON ANDERS (SE); BERGKVIST MIKAEL (SE)
Applicant: ASEA BROWN BOVERI (SE); EKBERG MATS (SE); SKYTT PER (SE); WINDMAR DAN (SE); SUNDIN MARIE (SE); SUNESSON ANDERS (SE); BERGKVIST MIKAEL (SE)
Classification:
- International: H02H9/00; H01T2/00
- european: H01T2/00
Application number: WO1999SE01101 19990617
Priority number(s): SE19980002182 19980617

Also published as:
SE9802182 (L)

Cited documents:
US3660721
EP0280759
US4184186
US4978893
US3398322
more >>

Abstract of **WO9967865**

A device for protecting, in a multiphase electric power plant for alternating voltage, one or more objects from over-currents and/or over-voltages, said objects being connected to an electric power network or another equipment comprised in the electric power plant, said device comprising an arrangement for reducing over-currents and/or over-voltages, said arrangement being activatable with the assistance of an arrangement detecting over-current and/or over-voltage conditions. The arrangement reducing over-currents and/or over-voltages comprises a plurality of electric closing means (9a), which each are coupled to phase conductors in the plant and which are closable to reduce occurring over-currents and/or over-voltages. Said plurality of closing means (9a) have their electrode gaps (16a) arranged within an enclosure (22a) common to the closing means. The device and the closing means (9a) thereof may also be used for general switching purposes.